1. The molar conductivity Λ at 18° C of a 0.0100M aqueous solution of ammonia is 9.6 S cm²/mol. Given Λ_0 values (in S cm2/mol) of 144.0 (OH^-), 65.6 (Cl^-) and 129.8 (NH_4Cl),

   a) Write down the ionization reaction for ammonia solution

   $$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

   b) What is Λ_0 for aqueous ammonia solution?

   $$\Lambda_0 = \Lambda_0(NH_4Cl) - \Lambda_0(Cl^-) + \Lambda_0(OH^-) = 208.2 \ \frac{S\,cm^2}{mol}$$

   c) What is the concentration of OH^- in solution?

   $$\alpha = \frac{\Lambda}{\Lambda_0} = \frac{9.6}{208.2} = 0.046, \ [OH^-] = c \cdot \alpha = 0.01 \cdot 0.046 = 4.6 \cdot 10^{-4}\,M$$

   d) What is the equilibrium constant for the reaction of a)

   $$K_{eq} = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{(c\alpha)^2}{c(1-\alpha)} = \frac{c\alpha^2}{1-\alpha} = \frac{0.01 \cdot 0.046^2}{1-0.046} = 2.48 \cdot 10^{-5}$$

2. The transport numbers of HCl at infinite dilution are estimated to be $t^+ = 0.821$ and $t^- = 0.179$. The molar conductivity 426.16 S cm²/mol. Calculate the ionic conductivities and mobilities of the hydrogen and chloride ions.

   $$\lambda_+ = 0.821 \cdot 426.16 \ \frac{S\,cm^2}{mol} = 349.9 \frac{S\,cm^2}{mol}$$

   $$\lambda_- = 0.179 \cdot 426.16 \ S\,cm^2/mol = 76.3 \ S\,cm^2/mol$$

   $$u_+ = \lambda_+/F = 349.9/96485 = 3.63 \times 10^{-3} \frac{cm^2}{s \cdot V}$$

   $$u_- = 7.91 \times 10^{-4} \frac{cm^2}{V \cdot s}$$

3. A solution of LiCl at a concentration of 0.01 M is contained in a tube with cross-sectional area of 5 cm². Calculate the speeds of the Li^+ and Cl^- ions if a current of 1 A is passed. Use ionic conductivities $\Lambda_0(Li^+) = 38.6$ S cm2/mol and $\Lambda_0(Cl^-) = 76.4$ S cm2/mol.

   - $\Lambda_0 = (38.6 + 76.4) \frac{S\,cm^2}{mol} = 115 \frac{S\,cm^2}{mol}, \ \kappa = \Lambda_0 \cdot c = 115.0 \times 10^{-5} \frac{S}{cm}$
   - $G = \kappa \cdot \frac{A}{\ell} = \frac{I}{\Delta V} \Rightarrow \frac{\Delta V}{\ell} = \frac{I}{A \cdot \kappa} = \frac{1\,A}{5\,cm^2 \cdot 115.0 \times 10^{-5} \frac{S}{cm}} = 173.9 \frac{V}{cm}$
   - $u(Li^+) = \Lambda_0(Li^+)/F = 4.00 \times 10^{-4} \frac{cm^2}{Vs}; \ u(Cl^-) = \Lambda_0(Cl^-)/F = 7.92 \times 10^{-4} \frac{cm^2}{Vs}$
   - $v(Li^+) = u(Li^+) \cdot \frac{\Delta V}{\ell} = 4.00 \times 10^{-4} \frac{cm^2}{V \cdot s} \cdot 173.9 \frac{V}{cm} = 0.070 \frac{cm}{s}$

   $v(Cl^-) = u(Cl^-) \cdot \frac{\Delta V}{\ell} = 0.138 \frac{cm}{s}$